

Patent claims

1. Transfer plant, especially for loading and unloading ISO containers from container ships at seaports, with a vertical support which is propped up at the land side and on which a horizontal extension arm is braced, which protrudes across the ship that is to be unloaded on the sea side and along which a horizontal conveying device can travel, which cooperates with hoisting and lowering devices that pick up and put down the containers, being arranged at the land and sea side and also on the horizontal extension arm, characterized in that  
at least two horizontal conveying devices (9, 10) are arranged on the horizontal extension arm (1.4, 1.5, 1.6), which can travel independently of each other between the land-side and sea-side hoisting and lowering devices (11, 13) along the horizontal extension arm (1.4, 1.5, 1.6).
2. Transfer plant per claim 1, characterized in that intermediate storage devices (12, 14) are arranged on the horizontal extension arm (1.4, 1.5, 1.6) in the region of the land-side and/or the sea-side hoisting and lowering devices (11, 13), where containers can be put down or picked up by the land-side or sea-side hoisting and lowering devices (11, 13), as well as the horizontal conveying devices (9, 10).
3. Transfer plant, especially for loading and unloading containers from container ships at seaports, with a vertical support which is propped up at the land side and on which a horizontal extension arm is braced, which protrudes across the ship that is to be unloaded on the sea side and along which a horizontal conveying device can travel, which cooperates with hoisting and lowering devices that pick up and put down the containers, being arranged at the land and sea side and also on the horizontal extension arm, characterized in that  
intermediate storage devices (12, 14) are arranged on the horizontal extension arm (1.4, 1.5, 1.6) in the region of the land-side and/or the sea-side hoisting and lowering devices (11, 13), where containers can be put down or picked up by the land-side or sea-side hoisting and lowering devices (11, 13), as well as the horizontal conveying devices (9, 10).
4. Transfer plant per claim 3, characterized in that at least two horizontal conveying devices (9, 10) are arranged on the horizontal extension arm (1.4, 1.5, 1.6), which can travel independently of each other between the land-side and sea-side hoisting and lowering devices (11, 13) along the horizontal extension arm (1.4, 1.5, 1.6).
5. Transfer plant per one of claims 1 to 4, characterized in that the horizontal extension arm is divided into a rigid base arm (1.4) at the sea side, a swivel arm (1.5) joined to it at the sea side, and a rigid extension arm (1.6) protruding at the land side; the rigid sea-side base arm (1.4) and the rigid land-side arm (1.6) are fastened to the vertical support (1.3), and the rigid sea-side base arm (1.4) accommodates the sea-side hoisting and lowering device (11) in the position of rest of the transfer plant, in which the sea-side swivel arm (1.5) is swiveled upward.
6. Transfer plant per one of claims 1 to 5, characterized in that the sea-side portion (1.4, 1.5) of the horizontal extension arm carries a railway (5) for a trolley (6) of the sea-side hoisting and lowering device (11), the land-side hoisting and lowering device (13) is fastened at the land-side portion (1.6) of the horizontal extension arm, and railways (7, 8) for the horizontal conveying devices (9, 10) are arranged on both sides next to the railway (5) of the sea-side hoisting and lowering device (11) and next to the land-side hoisting and lowering device (13) and thus essentially along the entire horizontal extension arm (1.4, 1.5, 1.6).
7. Transfer plant per claim 6, characterized in that the vertical support (1.3) is fashioned in the shape of a tower, the railway (5) for the hoisting and lowering device (11) ends in the region of the vertical support (1.3), and the railways (7, 8) for the horizontal conveying devices (9, 10) run laterally past the vertical support.
8. Transfer plant per one of claims 2 to 7, characterized in that the intermediate storage devices (12, 14) each comprise a downwardly extending support column (12.1, 14.1), at whose lower end is attached a

horizontal swivel arm (12.2, 14.2), at whose end away from the support column (12.1, 14.1) is hinged a carrying frame (12.3, 14.3), which can swivel both into the region underneath the sea-side or land-side hoisting and lowering device (11, 13) and into the region of the two horizontal conveying devices (9, 10) into corresponding pick-up and hand-off positions for the picking up or handing off of a container (19).

9. Transfer plant per claim 8, characterized in that the sea-side swivel arm (12.2) and the sea-side carrying frame (12.3) can each swivel at least  $\pm 90^\circ$  about their vertical axis, independently of each other.

10. Transfer plant per claim 8 or 9, characterized in that the swivel mechanism of the land-side carrying arm (14.2) and/or the land-side carrying frame (14.3) can be driven by a parallelogram type coupler mechanism (34), so that the orientation of the container (21) remains unchanged during the swivel motion.

11. Transfer plant per one of claims 8 to 10, characterized in that the carrying frame (12.3, 14.3) for the container (19, 21) can be swiveled into a central swivel position between the two pick-up and hand-off positions in the region of the railways (7, 8), where the container can be connected to or detached from the sea-side or land-side hoisting and lowering device (11).

12. Transfer plant per one of claims 1 to 11, characterized in that the horizontal conveying devices (9, 10) each consist of a frame (29) with a rail traversing mechanism (30) that can travel on the railways (7, 8), a hoisting mechanism (31) and a spreader (32) to receive the container (19) which has been swiveled and positioned underneath the spreader (32).

13. Transfer plant per one of claims 1 to 12, characterized in that the land-side hoisting and lowering device (13) is configured as a lift guided on the vertical support (1.3), which consists of a trolley (23), guided on a horizontal hoisting beam (13.1), with a load suspension means (22) for the container (21), wherein the hoisting beam (13.1) is suspended from hoisting cables (24) and linked by a cross rail (balancing arm 13.2) to guide rollers (13.3) that can roll against the vertical support (1.3).

14. Transfer plant per claim 13, characterized in that the hoisting cables (24) of the land-side hoisting and lowering device (13) are coupled to a mobile counterweight (33) to at least partly compensate for the natural weight of the land-side hoisting and lowering device (13).

15. Transfer plant per one of claims 1 to 14, characterized in that a loading station (15, 16) is arranged beneath the land-side hoisting and lowering device (13), having two pick-up and hand-off positions that can travel alternately underneath the hoisting and lowering device (13), cooperating with a horizontal conveying system (17).

16. Transfer plant per one of claims 1 to 15, characterized in that the transfer plant (1) has a gantry type substructure (1.1), supported on rail traversing mechanisms (1.2), the extension arm (1.6) protrudes across the substructure (1.1) on the land side, and the vertical support (1.3) is propped up centrally on the substructure (1.1) at the land side.

17. Method of loading and unloading of containers from container ships by means of a transfer plant (1), especially according to one or more of claims 1 to 16, with a vertical support (1.3) which is propped up at the land side and on which a horizontal extension arm (1.4, 1.5 and 1.6) is braced, which protrudes across the ship (3) that is to be unloaded on the sea side and along which a horizontal conveying device (9, 10) can travel, which cooperates with hoisting and lowering devices (11, 13) [sic] that pick up and put down the containers (18, 19, 21), being arranged at the land and sea side and also on the horizontal extension arm (1.4, 1.5 and 1.6), with at least two horizontal conveying devices (9, 10) arranged on the horizontal extension arm (1.4, 1.5, 1.6), which can travel independently of each other between the land-side and sea-side hoisting and lowering devices (11, 13) along the horizontal extension arm (1.4, 1.5, 1.6), and with intermediate storage devices (12, 14) arranged on the horizontal extension arm (1.4, 1.5, 1.6) in the region of the land-side and/or the sea-side hoisting and lowering devices (11, 13), where containers can be put down or picked up by the land-side or sea-side hoisting and lowering devices (11, 13), as well as the horizontal conveying devices (9, 10), characterized by the sequence of the following work steps:

- a) for the unloading from a container ship (3) tied up at the dock (2), a container (18, 19, 21) is picked up by a spreader (20) of the sea-side hoisting and lowering device (11), which has been positioned on the horizontal extension arm (1.4, 1.5, and 1.6) above the container (18, 19, 21), and raised to a maximum hoisting height,
- b) the intermediate storage device arranged on the sea-side hoisting and lowering device (11), with a horizontally swiveling carrying arm (12.2) and a horizontally swiveling carrying frame (12.3) arranged on it, is swiveled from its position of rest underneath a railway (7, 8) of the two horizontal conveying devices (9, 10) into a position underneath the container (18, 19, 21),
- c) the container (18, 19, 21) is placed down on the carrying frame (12.3) and swiveled along with it under one of the two railways (7, 8) of the horizontal conveying devices (9, 10),
- d) one of the horizontal conveying device[s] (9, 10) positioned above the container (18, 19, 21) on the carrying frame (12.3) receives the container (18, 19, 21) and transports it to the end of the land-side extension arm (1.6), while the sea-side hoisting and lowering device (11) picks up a new container (18, 19, 21),
- e) at the land-side end of the extension arm (1.6), the container (18, 19, 21) is handed off to a carrying frame (14.3) of a second intermediate storage device (14), having a downwardly extending support column (14.2), which has been swiveled by a horizontal swivel arm (14.1) into the region of the railways (7, 8) of the horizontal conveying devices (9, 10) underneath the container (18, 19, 21),
- f) after detaching the container (18, 19, 21) from the horizontal conveying device (9, 10), the carrying frame (14.3) with the container (18, 19, 21) is swiveled under the hoisting mechanism of the hoisting and lowering device (13) hinged to the land-side extension arm (1.6), where the container (18, 19, 21) is picked up by a spreader (22),
- g) after the carrying frame (14.3) swivels back, the container (18, 19, 21) is lowered by the hoisting and lowering device (13) and handed off to a horizontal conveying system (15, 16) on the ground,
- h) at the same time as the above-described work steps, a second container (18, 19, 21) picked up by the sea-side hoisting and lowering device (11) is transported by the second horizontal conveying device (9, 10) across its other railway (7, 8) to the end of the extension arm (1.6) at the land side, where it is handled in the same fashion, and
- i) the above-mentioned work steps are performed in reverse sequence for the loading process.

18. Method per claim 17, characterized in that the container (18, 19, 21) oriented transversely to the lengthwise axis of the extension arm when picked up by the first hoisting and lowering device (11) is swiveled into a predetermined position parallel to the extension arm (1.4, 1.5, 1.6) by the carrying arm (12.2) and/or carrying frame (12.3) swiveling through  $\pm 90^\circ$ .

19. Method per claim 17 or 18, characterized in that the container (18, 19, 21) oriented parallel to the extension arm (1.4, 1.5, 1.6) when placed on the carrying frame (14.3) of the second land-side hoisting and lowering device (13) remains unchanged in its orientation when swiveled into the region of the hoisting and lowering device (13) thanks to opposite swivel movements of the carrying arm (14.2) and carrying frame (14.3).